WHAT IS CLAIMED IS:

1. An image processing system comprising a first image processing apparatus which records, on a recording medium, composite image information created by embedding invisible sub-information in visible main image information, and a second image processing apparatus which restores the sub-information from the composite image information recorded on the recording medium by the first image processing apparatus,

the first image processing apparatus including

a pre-processing unit which performs, for main image information, pre-processing corresponding to pixel formation processing for image recording in the first image processing apparatus,

an embedding processing unit which creates composite image information by embedding sub-information in main image information in an invisible state using the main image information, the sub-information, and key information used to restore the sub-information, and

a recording unit which records the composite image information created by the embedding processing unit on a recording medium, and

the second image processing apparatus including

an image input unit which inputs the composite image information from the recording medium on which the composite image information is recorded by the

recording unit of the first image processing apparatus,

a frequency component extracting unit which extracts a spatial frequency component unique to the key information from the composite image information input by the image input unit, and

a reconstructing unit which reconstructs the sub-information from the spatial frequency component extracted by the frequency component extracting unit.

2. An image processing system comprising a first image processing apparatus which records, on a recording medium, composite image information created by embedding invisible sub-information in visible main image information, and a second image processing apparatus which restores the sub-information from the composite image information recorded on the recording medium by the first image processing apparatus,

the first image processing apparatus including

a first pre-processing unit which performs, for main image information, first pre-processing corresponding to pixel formation processing for image recording in the first image processing apparatus,

a second pre-processing unit which performs geometric transformation with respect to the main image information having undergone the first pre-processing by the first pre-processing unit,

an embedding processing unit which creates composite image information by embedding

sub-information in main image information in an invisible state using the main image information, the sub-information, and key information used to restore the sub-information,

an inverse transformation unit which performs transformation processing inverse to the transformation processing by the second pre-processing unit with respect to the composite image information created by the embedding processing unit, and

a recording unit which records the composite image information having undergone the inverse transformation processing by the inverse transformation unit by an alternate driving/recording scheme of alternately forming even-numbered and odd-numbered pixels in a main scanning direction of a recording device on a recording line basis, and

the second image processing apparatus including

an image input unit which inputs the composite image information from the recording medium on which the composite image information is recorded by the recording unit of the first image processing apparatus,

a frequency component extracting unit which extracts a spatial frequency component unique to the key information from the composite image information input by the image input unit, and

a reconstructing unit which reconstructs the sub-information from the spatial frequency component

extracted by the frequency component extracting unit.

3. A system according to claim 2, wherein the first pre-processing unit thins out main image information in accordance with pixel formation processing for image recording in the first image processing apparatus.

4. A system according to clam 3, wherein the second pre-processing unit rotates the main image information, which is thinned out by the first pre-processing unit in advance, through a predetermined angle, and then performs geometric transformation to remove thinned-out portions from the main image information, compresses effective portions of the main image information, and performs reconstruction.

5. A system according to claim 2, wherein the frequency component extracting unit extracts a spatial frequency component of the key information from the composite image information input by the image input unit by using a frequency filter coefficient.

6. A system according to claim 2, wherein the reconstructing unit extracts a change point at which a sign changes from the spatial frequency component extracted by the frequency component extracting unit, obtains a reference phase of the spatial frequency component by projecting the extracted change point, calculates a deviation of each coordinates of the spatial frequency component extracted by the frequency

component extracting unit from the obtained reference phase, and replaces a pixel value of a coordinate which deviates by not less than a predetermined threshold with a first value, and each of other pixel values with a second value, thereby reconstructing sub-information.

7. A system according to claim 2, further comprising a determining unit which determines authenticity of the recording medium on the basis of the sub-information reconstructed by the reconstructing unit.

8. An image processing apparatus comprising:

an image input unit which inputs composite image information from a recording medium on which the composite image information is recorded, which is created by color difference modulation processing using visible main image information, sub-information embedded in the main image information in an invisible state, and key information used to restore the sub-information;

a frequency component extracting unit which extracts a spatial frequency component unique to the key information from the composite image information input by the image input unit; and

a reconstructing unit which reconstructs the sub-information from the spatial frequency component extracted by the frequency component extracting unit.

9. An apparatus according to claim 8, wherein the

frequency component extracting unit extracts a spatial frequency component of the key information from the composite image information input by the image input unit by using a frequency filter coefficient.

10. An apparatus according to claim 8, wherein the reconstructing unit extracts a change point at which a sign changes from the spatial frequency component extracted by the frequency component extracting unit, obtains a reference phase of the spatial frequency component by projecting the extracted change point, calculates a deviation of each coordinates of the spatial frequency component extracted by the frequency component extracting unit from the obtained reference phase, and replaces a pixel value of a coordinate which deviates by not less than a predetermined threshold with a first value, and each of other pixel values with a second value, thereby reconstructing sub-information.

11. An apparatus according to claim 8, further comprising a determining unit which determines authenticity of the recording medium on the basis of the sub-information reconstructed by the reconstructing unit.

12. An image processing apparatus comprising:

an image input unit which inputs composite image information from a recording medium on which the composite image information is recorded, which is created by color difference modulation processing using

visible main image information, sub-information embedded in the main image information in an invisible state, and key information used to restore the sub-information;

a color component information storage unit which stores color component information;

a color component extracting unit which extracts a color component from the composite image information input by the image input unit on the basis of the color component information stored in the color component information storage unit;

a frequency component extracting unit which extracts a spatial frequency component unique to the key information from the color component extracted by the color component extracting unit; and

a reconstructing unit which reconstructs the sub-information from the spatial frequency component extracted by the frequency component extracting unit.

13. An apparatus according to claim 12, wherein the color component extracted from the composite image information is a color component corresponding to a color of ink exhibiting a highest gradation characteristic when the composite image information is recorded, and information of the color component is stored in the color component information storage unit.

14. An apparatus according to claim 12, wherein the color component extracted from the composite image

information is a color component corresponding to a color of ink exhibiting a highest gradation characteristic when the composite image information is input, and information of the color component is stored in the color component information storage unit.

15. An image processing apparatus comprising:

an image input unit which inputs composite image information from a recording medium on which the composite image information is recorded, which is created by color difference modulation processing using visible main image information, sub-information embedded in the main image information in an invisible state, and key information used to restore the sub-information;

an area extracting unit which extracts a local area from the composite image information input by the image input unit;

a color feature extracting unit which extracts a color feature in the local area extracted by the area extracting unit from the local area;

a color combining unit which creates color component composite image information by combining color components on the basis of the color feature extracted by the color feature extracting unit;

a frequency component extracting unit which extracts a spatial frequency component unique to the key information from the color component composite

image information created by the color combining unit; and

a reconstructing unit which reconstructs the sub-information from the spatial frequency component extracted by the frequency component extracting unit.

16. An image processing apparatus comprising:

an image input unit which inputs composite image information from a recording medium on which the composite image information is recorded, which is created by color difference modulation processing using visible main image information, sub-information embedded in the main image information in an invisible state, and key information used to restore the sub-information;

an area extracting unit which extracts a local area from the composite image information input by the image input unit;

a color feature extracting unit which extracts a color feature in the local area extracted by the area extracting unit from the local area;

a reconstruction parameter determining unit which determines a reconstruction parameter on the basis of the color feature extracted by the color feature extracting unit;

a frequency component extracting unit which extracts a spatial frequency component unique to the key information from the composite image information

input by the image input unit; and

a reconstructing unit which reconstructs the sub-information from the spatial frequency component extracted by the frequency component extracting unit by using the reconstruction parameter determined by the reconstruction parameter determining unit.

17. An apparatus according to claim 16, wherein the reconstruction parameter comprises an amplification coefficient for amplifying the spatial frequency component, and the reconstructing unit includes an amplifying unit which amplifies the spatial frequency component by using the amplification coefficient.

18. An apparatus according to claim 16, wherein the reconstruction parameter comprises a threshold for binarizing the spatial frequency component, and the reconstructing unit includes a binarizing unit which binarizes the spatial frequency component by using the threshold.

19. An image processing method comprising:

inputting composite image information from a recording medium on which the composite image information is recorded, which is created by color difference modulation processing using visible main image information, sub-information embedded in the main image information in an invisible state, and key information used to restore the sub-information;

extracting a spatial frequency component unique

to the key information from the composite image information input from the recording medium; and

reconstructing the sub-information from the spatial frequency component extracted by extracting the frequency component.

20. A method according to claim 19, wherein extracting the frequency component includes extracting a spatial frequency component of the key information from the composite image information input from the recording medium by using a frequency filter coefficient.

21. A method according to claim 19, wherein reconstructing includes extracting a change point at which a sign changes from the spatial frequency component, obtaining a reference phase of the spatial frequency component by projecting the extracted change point, calculating a deviation of each coordinate of the spatial frequency component from the reference phase, and replacing a pixel value of a coordinate which deviates by not less than a predetermined threshold with a first value, and each of other pixel values with a second value, thereby reconstructing sub-information.

22. A method according to claim 19, further comprising determining authenticity of the recording medium on the basis of the reconstructed sub-information.

23. An image processing method comprising:

inputting composite image information from a recording medium on which the composite image information is recorded, which is created by color difference modulation processing using visible main image information, sub-information embedded in the main image information in an invisible state, and key information used to restore the sub-information;

extracting a color component from the composite image information input from the recording medium on the basis of the color component information stored in a color component information storage unit;

extracting a spatial frequency component unique to the key information from the extracted color component; and

reconstructing the sub-information from the extracted spatial frequency component.

24. An image processing method comprising:

inputting composite image information from a recording medium on which the composite image information is recorded, which is created by color difference modulation processing using visible main image information, sub-information embedded in the main image information in an invisible state, and key information used to restore the sub-information;

extracting a local area from the composite image information input from the recording medium;

extracting a color feature in a local area extracted the composite image information from the local area;

creating color component composite image information by combining color components on the basis of the color feature extracted from the local area;

extracting a spatial frequency component unique to the key information from the created color component composite image information; and

reconstructing the sub-information from the extracted spatial frequency component.

25. An image processing method comprising:

inputting composite image information from a recording medium on which the composite image information is recorded, which is created by color difference modulation processing using visible main image information, sub-information embedded in the main image information in an invisible state, and key information used to restore the sub-information;

extracting a local area from the composite image information input from the recording medium;

extracting a color feature in the extracted local area from the local area;

determining a reconstruction parameter on the basis of the color feature extracted from the local area;

extracting a spatial frequency component unique

to the key information from the composite image information input from the recording medium; and

reconstructing the sub-information from the spatial frequency component extracted by extracting the frequency component by using the reconstruction parameter determined on the basis of the color feature.